Air Force Research Laboratory | AFRL

Science and Technology for Tomorrow's Aerospace Force

Air Force S&T Initiatives

Maj Gen Paul Nielsen
Commander

Our Vision and Mission

AIR FORCE MISSION

To defend the United States through control and exploitation of air and space

AIR FORCE RESEARCH LABORATORY MISSION

Leading the discovery, development, and integration of affordable warfighting technologies for our aerospace forces

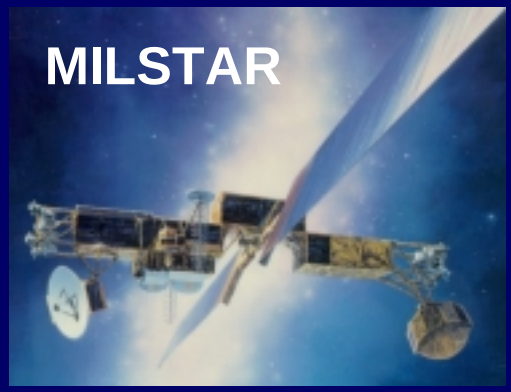
AIR FORCE RESEARCH LABORATORY VISION

We defend America by unleashing the power of innovative aerospace technology

Agenda

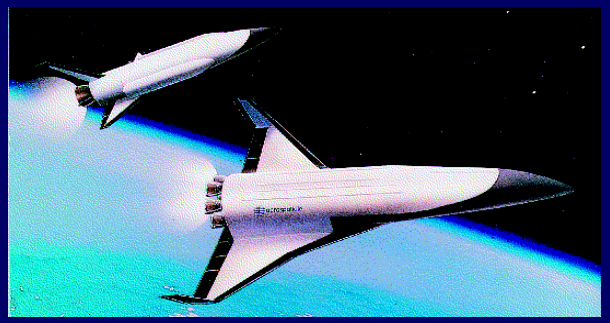
- Long Range Pay-off of S&T
- Update on AFRL
- Cutting Edge Technologies
- Closing Thoughts

Contributions From Past Investments



Predictions for the Future

Aerospace Vehicle



Mach 6 Global Reach Strike Aircraft

Space Based Laser

Combined Aerospace Ops Center (CAOC) of the Future

USS Billy Mitchell

National Missile Defense

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1990 Reorganization of the Air Force Labs

Air Force Space Tech Ctr
Kirtland AFB, NM

- Astronautics Lab
- Weapons Lab
- Geophysics Lab

→ **Phillips Lab, Kirtland AFB**

Wright R&D Center
Wright-Patterson AFB, OH

- Avionics Lab
- Electronics Technology Lab
- Flight Dynamics Lab
- Materials Lab
- Aero Propulsion & Power Lab
- AF Armament Lab

→ **Wright Lab, Wright-Patterson AFB**

Human Systems Division
Brooks AFB, TX

- Armstrong Aerospace Medical Research Lab
- AF Human Resources Lab
- AF Drug Testing Lab
- AF Occupational & Environmental Health Lab

→ **Armstrong Lab, Brooks AFB**

Rome Air Development Center
Griffiss AFB, NY

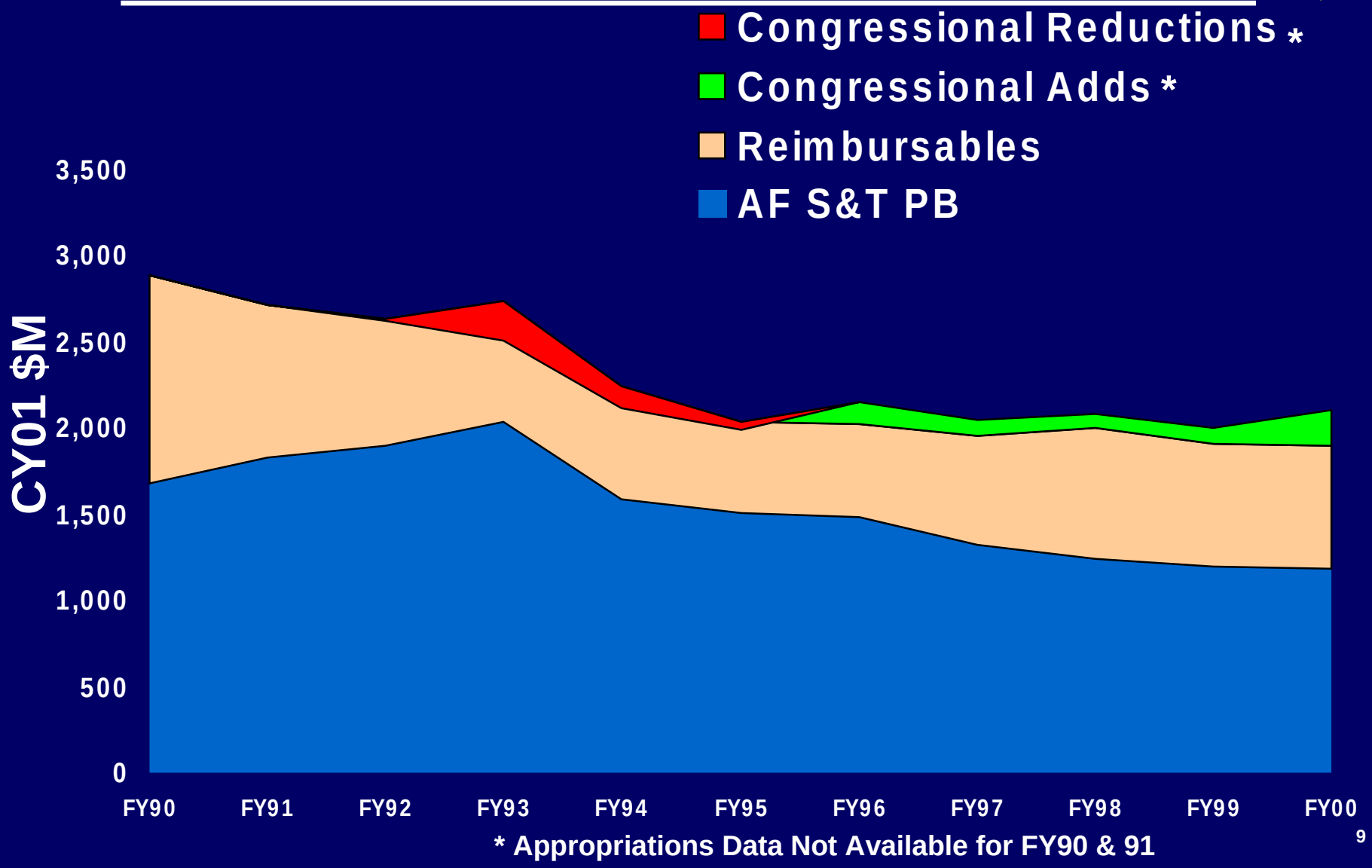
→ **Rome Lab, Griffiss AFB**

Air Force Research Laboratory

From many labs and staffs...

…To the Air Force's Single Laboratory

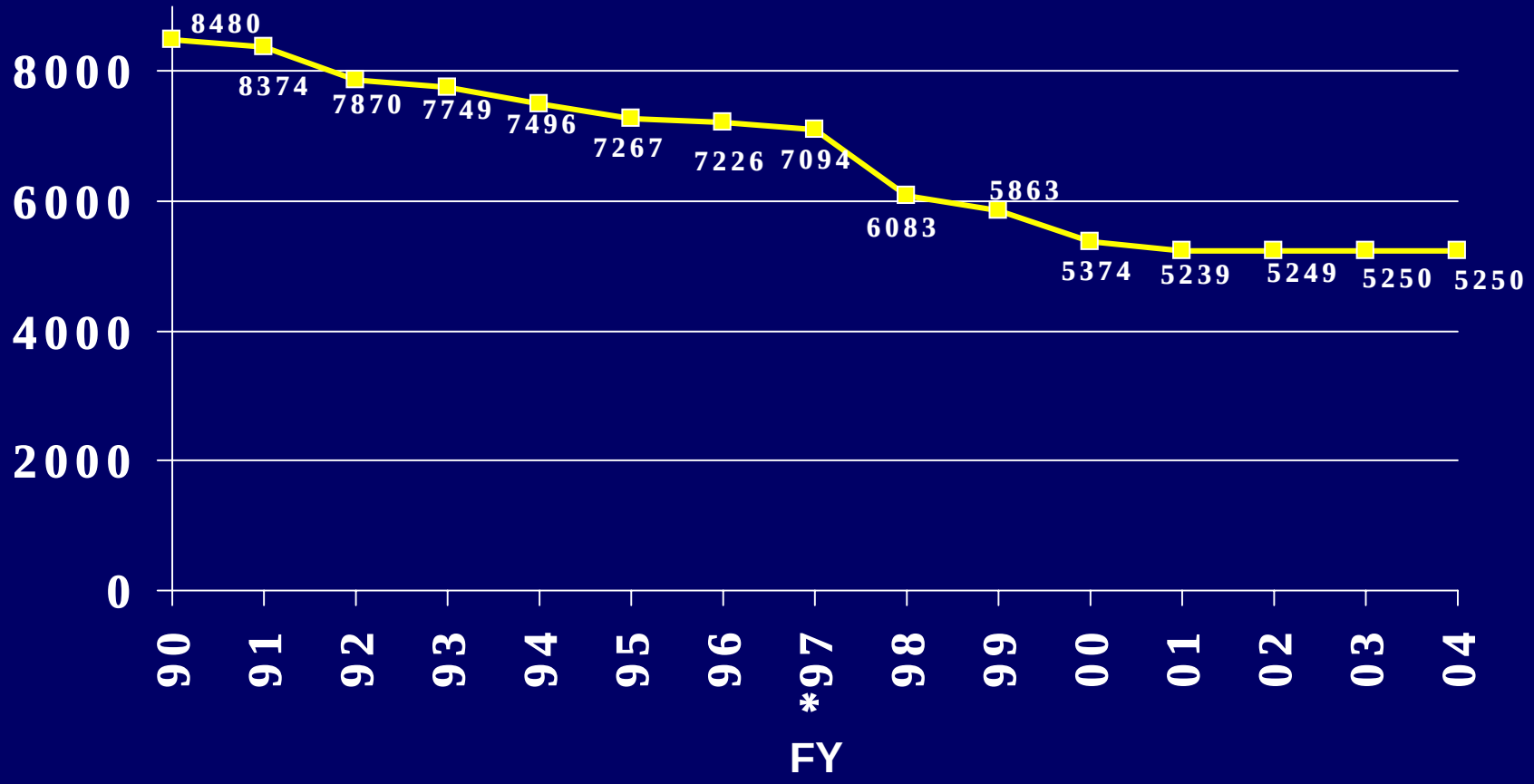
S&T Funding -- All Sources
(CY01$)



* Appropriations Data Not Available for FY90 & 91

As of: EOM Sep 00

Authorized Manning by Fiscal Year

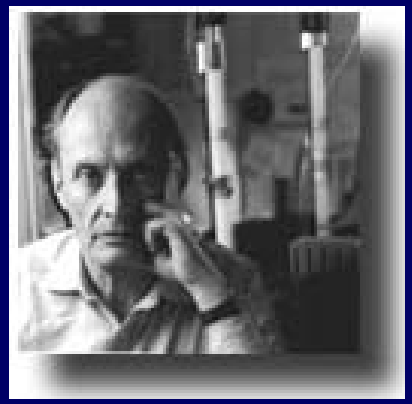


* FY97 was the stand-up of AFRL. FY97 and prior includes authorizations of the 4 separate Labs, HQ/ST Staff and PEC 8 medical authorizations. Medical authorizations transferred d back to HSW between FY97/98.

Data Points show End of FY Manning

Source: End of Year UMDs

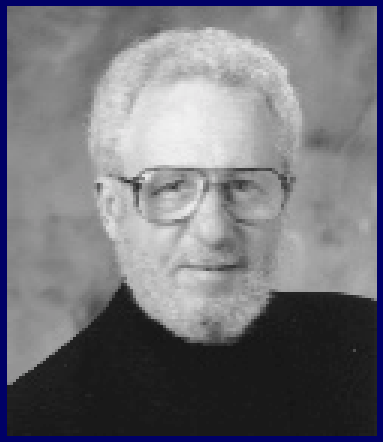
Nobel Laureates for 2000



Dr. Paul Greengard, *Rockefeller University*

Nobel Prize in Medicine

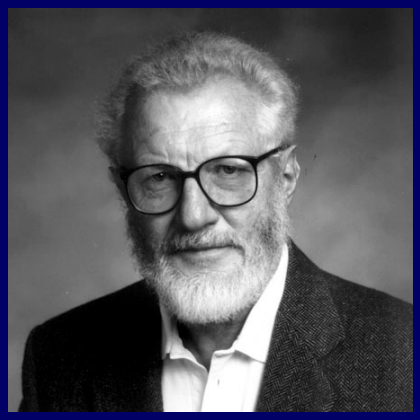
- For discoveries of synaptic transmission mechanisms between human nerve cells
- AF S&T supported since 1984



Dr. Alan J. Heeger, *UC Santa Barbara*

Nobel Prize in Chemistry

- For research on electricity-conducting plastic
- AF S&T supported since 1988



Dr. Herbert Kroemer, *UC Santa Barbara*

Nobel Prize in Physics

- For research on microelectronic components
- AF S&T supported since 1995

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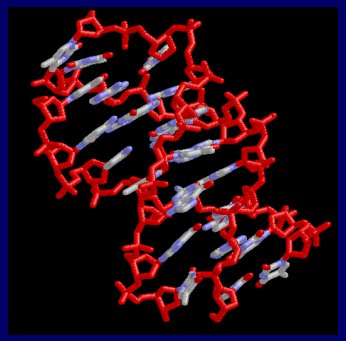
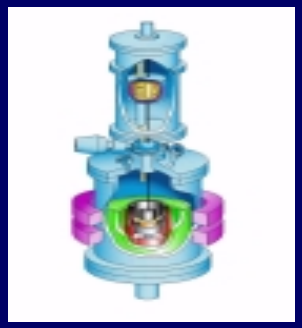
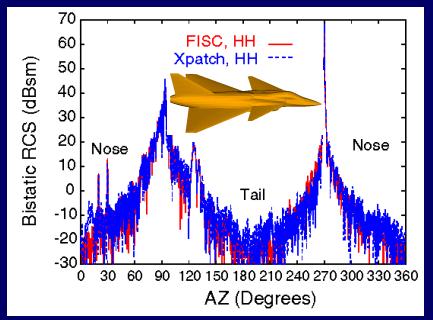
Office of Scientific Research
Technology Thrusts

Aerospace and Materials Sciences	Chemistry and Life Sciences	Physics and Electronics	Mathematics and Space Sciences
			

Core Sub-thrusts

• Hypersonics • Advanced Materials • Space Propulsion • Nanotechnology	• Bioenvironmental Science • Biomimetics • Molecular Dynamics	• Photonic, Plasma, & Imaging Physics • Space Electronics • Optoelectronics	• Computational Modeling • Space Physics • Electromagnetics

• High Cycle Fatigue • Smart Structures • Plasma Aerodynamics • Shape Memory Alloys	• IR Biosensors • All-Nitrogen Rocket Fuel • Agile Laser Protection	• Radiation Hardened Electronics • Microsatellites • Isomeric Energy Storage	• Identifying Hard Targets • Quantum Computers • Targeting Through Turbulence

Basic Research & Enabling Technologies

Munitions Directorate
Technology Thrusts

Defeat Fixed Targets

Defeat Mobile Targets

Defeat Air Targets

Application Sub-thrusts

- All Weather Precision Guidance
- Range Extension
- Agent Defeat
- Smart & Multi Event Fuzing
- High Speed Penetration
- Antijam GPS

- ATR Development
- Directional Warheads
- High Resolution LADAR
- Smart Sensor Web
- Propulsion Integration
- Smart Rack

- All Aspect Intercept
- Directional Warhead
- Guidance Integrated Fuzing
- Jet Reaction Control

- Advanced Energetics
- High Strain Rate Material
- Nano Particles
- Hydro-code Modeling & Simulation

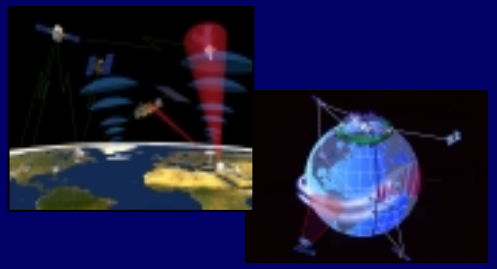
- Self Forging Penetrators
- Cooperative Attack
- Solid State LASER

- Optimal Guidance
- High Angle of Attack
- Target Imaging
- Burst Point Fuzing

Basic Research & Enabling Technologies

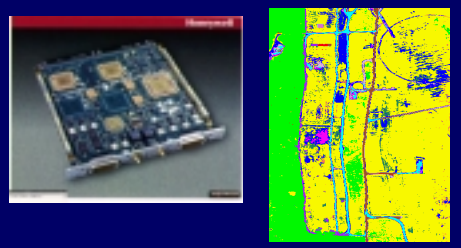
Space Vehicles Directorate
Technology Thrusts

Space Systems Protection



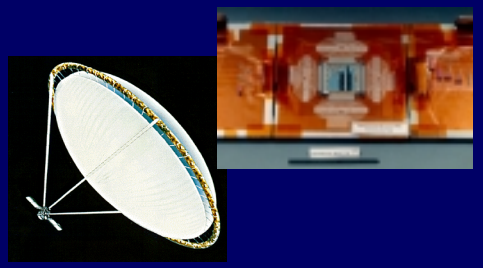
- Space Hazards Warning & Mitigation
- Ionspheric Specification & Forecasting
- Background Clutter Prediction, Detection & Decision Aids
- Threat Warning & Attack Reporting

Spacecraft Payloads



- Rad Hard Microelectronics
- Advanced Packaging
- Space IR Technologies
- Space Antenna Technologies
- HSI Technologies
- Modeling & Simulation
- Intelligent Satellite Systems

Spacecraft Vehicles



- Spacecraft Structures
- Launch Vehicle Structures
- Controls & Mechanisms
- Space Power
- Cryocoolers
- Small Sat Integration & Ground Support Tech
- Microsatellite Concepts & Technologies

Integrated Space Technology Demonstrations

Warfighter-1
XSS-11
Ballistic Missile Technology

Space Maneuver Vehicle
Upper Stage Flight Experiment
Low Cost Launch Vehicle Technology (Scorpius)
MicroSat Technology (XSS-10)

Information Directorate
Technology Thrusts

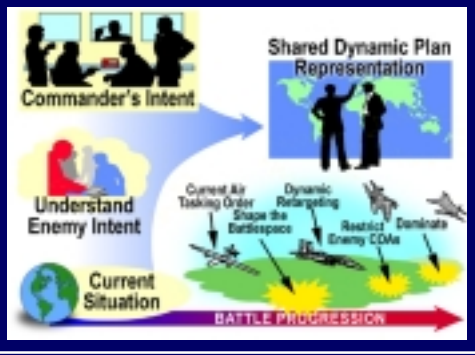
Global Awareness

Provide consistent, integrated battlespace information on demand, tailored to the needs of individual warfighters

- Automated exploitation tools
- Fusion of information into single consistent operating picture providing situational awareness & impact assessment
- Affordable global information base supporting real-time exploitation & fusion

Dynamic Planning & Execution

Provide commanders with the ability to shape and control the pace and phasing of engagements, exploiting global awareness and global information exchange capabilities



- Predictive planning & preemption
- Integrated force mgmt & execution
- Real time sensor to shooter operations
- Collaborative, distributed real-time mission planning, training, & battlespace simulation

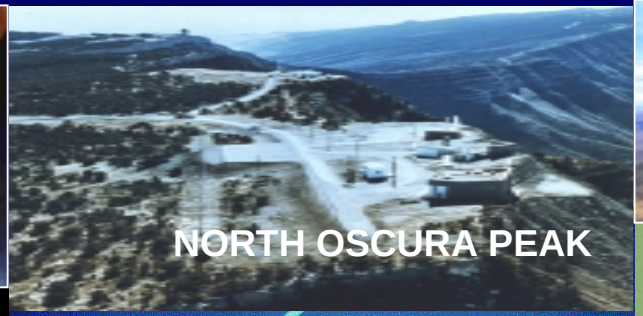
Global Information Exchange

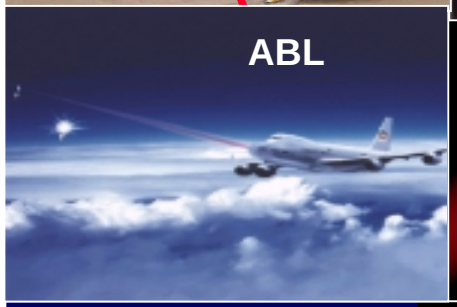
Assure information anywhere, anytime, for any mission through adaptable and scaleable information systems

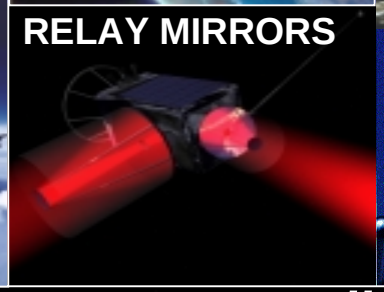
- Seamless, collaborative workspaces
- x1000 increase in global comm to aircraft capability
- Continuous in-transit visibility
- World-wide information -- on demand
- Information Warfare -- protect, detect, react
- Assured & survivable networking

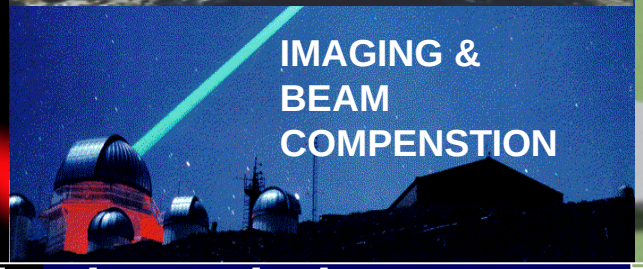
Directed Energy Directorate
Technology Thrusts

Lasers | Advanced Optics & Imaging | HPM









Application Sub-thrusts

- Strategic HELs
- Tactical HELs
- A/C Protection
- Targeting Lasers

- Large Optics
- Relay Mirrors
- Remote Optical Sensing

- GBL Beam Control
- ABL Target Track
- Space Situational Awareness

- Non-Lethal
- Electronic Attack
- A/C Protection

- Solid-State Lasers
- Chem Lasers
- Tunable Lasers
- Effects/ Modeling

- Optical Coatings
- Membrane Mirrors
- Large Apertures

- Innovative Algorithms
- Target & Modeling
- Adaptive Optics
- Non-Linear Optics

- Sources
- A/C Integration
- Effects/Modeling
- Antennas

Basic Research & Enabling Technologies

Air Vehicles Directorate
Technology Thrusts

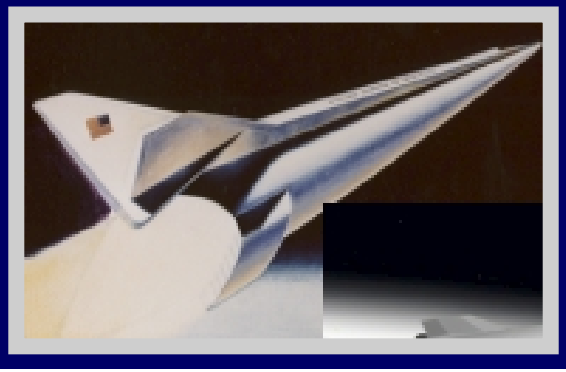
Sustainment
Technology insertion to enable today's fleet to meet tomorrow's warfighter needs

Aging Fleet
Over 75% of military aircraft exceed 20 years service, many to operate for over 50 years. Result: Huge O&M costs; big cause - cracking and corrosion

Unmanned Air Vehicles
Technologies to enable routine operation of high payoff UAV alternatives across the full spectrum of warfare

UAV Alternatives
Aggressively pursue emerging technologies to develop, field, & operate UAVs for military roles across the spectrum of warfare ...based on cost, capability, reliability, and suitability.

Space Access and Future Strike Technologies
Affordable space access and quick reaction trans-atmospheric capability



Assured Access to Space
- Affordable spacelift
- Aircraft-like operations

Future Strike Technologies
Capable of launching from CONUS and reaching global targets within hours

Propulsion Directorate
Technology Thrusts

Air Platforms

Space Platforms

Weapons

Application Sub-thrusts

- Fighters / Bombers / Transports
- Unmanned Aerial Vehicles
- Space Boosters
- Orbit Transfer
- Spacecraft
- Air-Launched Missiles
- Strategic Missiles
- Directed Energy

Basic Research & Enabling Technologies

- Gas Turbines
- Secondary Power
- Fuels and Lubrication
- Combustion
- Liquid & Solid Rockets
- Electric Propulsion
- Power & Thermal Mgmt
- Propellants
- Solid Rockets
- Scramjets
- Megawatt Power
- Nozzle Plumes

Human Effectiveness Directorate
Technology Thrusts

Warfighter Training	Crew System Interface	Bioeffects & Protection	Deployment & Sustainment
			

Core Sub-thrust

- Knowledge Representation
- Distributed Mission Training
- Night Vision Training
- Information Systems Training
- Visual Displays
- Aural Displays & Bioacoustics
- Information Analysis & Exploitation
- Interface Technology
- Crew Systems Integration
- Optical Radiation Bioeffects
- Radio Frequency Radiation
- Biomechanisms Modeling
- Aircrew Protection
- Logistics
- Toxicology
- Chemical & Biological Defense*
- Sustained Crew Operations

*DoD PE

Basic Research & Enabling Technologies

Materials & Manufacturing Technology Thrusts

M&P for Structures and Propulsion

M&P for Sensors and Survivability

M&P for Sustainment and Deployment

Core Sub-Thrusts

- Metals
- Composites
- Ceramics
- High Cycle Fatigue
- Composites Affordability
- Thermal Protection
- IHPTET Materials
- IHPRPT Materials

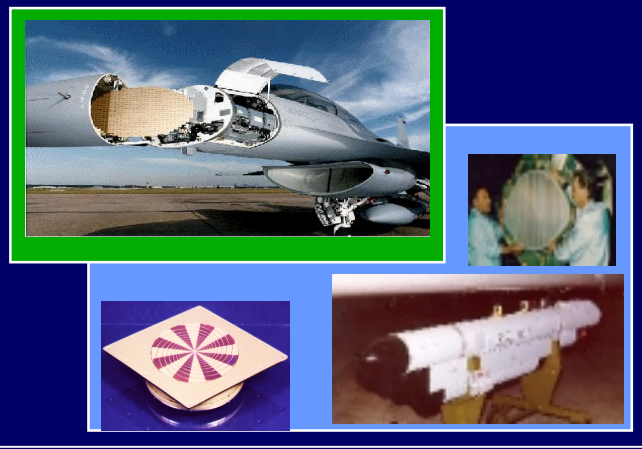
- Sensor Materials
- Laser Hardened Materials
- Polymers
- IR Sensor Materials
- Laser Protective Coatings & Devices
- Power Generation
- Conducting Polymers

- NDE
- Systems Support
- AEF Technologies
- Coatings
- Aging Systems NDE
- Deployed Base Support
- Failure Analysis
- Force Protection
- LO Maintainability

Basic Research & Enabling Technologies

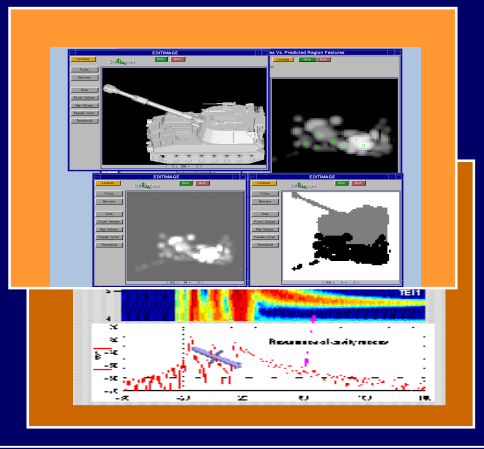
Sensors Directorate
Technology Thrusts

Radio Frequency Sensors & Countermeasures



Electro-Optical Sensors & Countermeasures

Automatic Target Recognition & Sensor Fusion



Application Sub-thrusts

- Radar
- Assured Reference
- Electronic Warfare
- Target Detection & ID
- Threat Warning & CM
- Space & Air Sensor ATR
- Precision ID & Location
- ATR Spiral Development

- Apertures
- Algorithms & Phenomenology
- Digital Receivers & Exciters
- Receivers
- Transceivers
- Algorithms & Phenomenology
- Innovative Algorithms
- Target & Phenomenology Modeling
- Evaluation Science

Basic Research & Enabling Technologies

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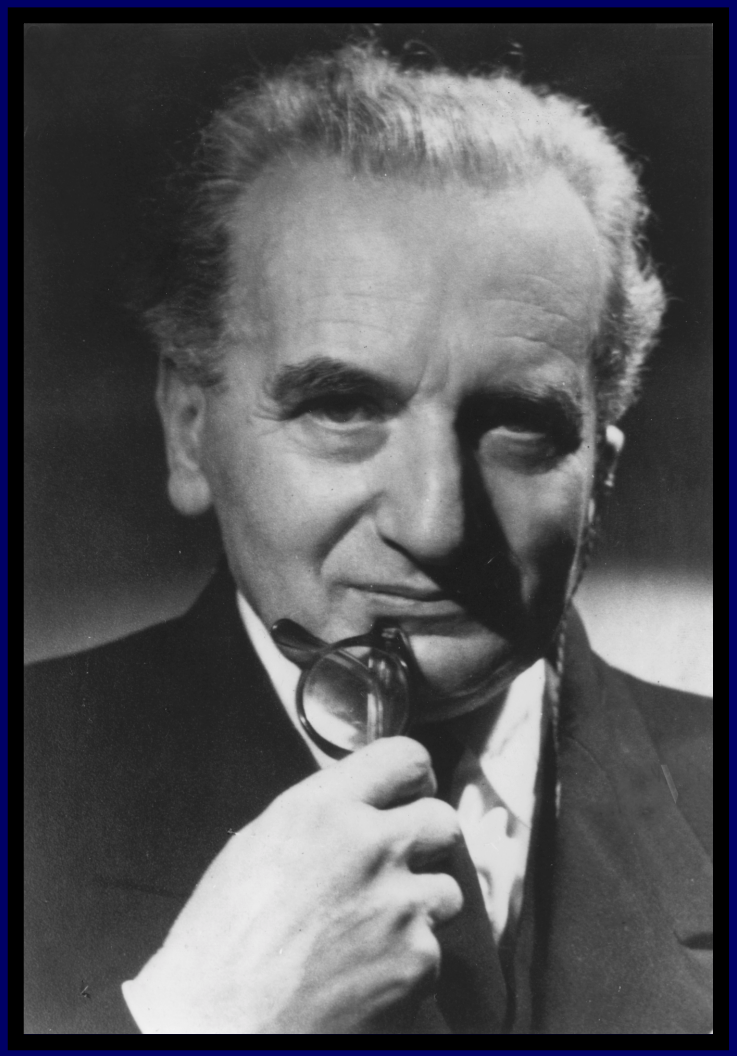

"Science is the key to air supremacy."

DR. THEODORE VAN KARMAN

"The first essential of airpower is pre-eminence in research."

GENERAL H. H. ARNOLD